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Population biology/Biologie des populations

Current distribution and characterization of the wild grapevine populations in Andalusia (Spain)

Distribution et caractérisation actuelles des populations sauvages de vigne en Andalousie (Espagne)

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ABSTRACT

For decades, human activities have gradually destroyed the natural habitats of wild grapevine, *Vitis vinifera* L. subsp. *sylvestris* (Gmelin) Hegi, and nowadays this species is endangered in southern Europe. In this paper, 94 populations of this species have been localized and characterized in the Andalusian region in the Iberian Peninsula between 1989 and 2013. Location, ecological aspects, and sanitary characteristics are described. Most properties and *in vitro* tolerance to calcareous conditions were also checked. The paper also contains a global description of female and male individuals. Two hundred individuals from six river basin populations have been sampled, and their genetic structure analyzed by using 25 nuclear microsatellites loci to investigate the gene diversity of wild grape populations in Andalusia at two levels: total individuals and at river basin populations. Also, the genetic relationship of wild and cultivated accessions has been tested. Wild grapevine is considered the ancestor of the cultivated varieties and should be preserved as this material could be used to start breeding programs of cultivated varieties and also to restore riverbank forests, which constitute one of the worst preserved ecosystems in the area.

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R É S U M É

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Pendant des décennies, les activités humaines ont progressivement détruit les habitats naturels de la vigne sauvage, *Vitis vinifera* L. subsp. *sylvestris* (Gmelin) Hegi et, de nos jours, cette espèce est menacée dans le Sud de l'Europe. Dans cet article, 94 populations de cette espèce ont été localisées et caractérisées en Andalousie, dans la péninsule Ibérique, entre 1989 et 2013. L'emplacement, les aspects écologiques et les caractéristiques sanitaires sont décrits. Les propriétés du moût et la tolérance *in vitro* aux conditions calcaires ont été également vérifiées. L'étude contient pareillement une description globale des individus féminins et masculins. Deux cents individus de six populations de bassins fluviaux ont été échantillonnés et leurs structures génétiques analysées en utilisant 25 microsatellites nucléaires pour étudier la diversité génétique des populations de raisins sauvages en Andalousie à deux niveaux : les individus totaux et les populations de bassins fluviaux. De plus, la relation génétique des accessions sauvages et cultivées a été testée. La vigne sauvage est considérée comme l'ancêtre des variétés cultivées et elle doit être préservée, car elle pourrait être utilisée pour lancer des programmes de sélection de variétés cultivées et pour restaurer les forêts riveraines, qui constituent l'un des écosystèmes les plus préservés de la région.

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1. Introduction

Andalusia is a Spanish region situated in the South of the Iberian Peninsula, spreading out 87,268 km² with a coastline around 800 km long. Due to its location the region is under a Mediterranean climatology. Grapevine has been present in this territory from ancient times as proves the pollen grains conserved in El Padul bog (Granada province) attributed to the Middle Pleistocene [1] or in the Laguna de Las Madres in Mazagón (Huelva province) datable back to 4500 BP [2].

Several archaeological findings demonstrate that grapevine cultivation existed in the region throughout the first millennium BC [3], mainly linked to Phoenician colonies situated along the Atlantic and Mediterranean coasts of Andalusia [4,5].

More recently, before the arriving in the 19th century of the North American parasitic species, powdery and downy mildews and phylloxera, 119 cultivars could be found in the region [6]. At present, Zalema, Palomino fino, Pedro Ximenez, Muscat of Alexandria, and other minor varieties, such as Tintilla de Rota, Rome and Vigiriega among others, are practically the only traditional cultivars still in use in the area [7]. Meanwhile, Tempranillo and several international varieties, mainly Cabernet Sauvignon, Merlot, Petit Verdot, and Shyrah, have recently spread in the area in order to improve red wine quality.

Wild grapevine (*Vitis vinifera* L. ssp. *sylvestris* (Gmelin) Hegi) is a dioecious subspecies considered the parental of the cultured grapevine (*Vitis vinifera* L. ssp. *sativa* (DC) Hegi). In fact, microsatellite DNA analysis has shown that Iberian wild vines have provided the A chlorotype to autochthonous grapevine cultivars from Andalusia and other Iberian regions [8].

Wild grapevine was linked to different human activities in the Iberian Peninsula, and concretely in Andalusia it has been used during millennia to produce must, wine, vinegar, ropes, fishing traps and also as rootstock [9,10]. Bunches have been found in burials from the Argar

culture as a part of funerary rituals [11]. The seeds found have morphological characteristics similar to those of the wild ones described by [12]. Berries were collected to produce homemade vinegar in the provinces of Cádiz and Jaén, and stems were used to produce fishing traps for lobster in the province of Cádiz up to about 25 years ago [13]. As stated above, the number of cultured grape varieties has been drastically reduced, leading to a huge loss of biodiversity in the Andalusian vineyard. This fact constitutes a serious drawback in the case of the appearance of new pests and diseases as well as to face the forthcoming climate change. Genetic diversity is crucial for food production, for the environment, and for sustainable development [14]. In this context, it should be very important to prospect and conserve the wild parentals of the current crops as wild grapevine is.

Moreover, some wild grapevine populations show a higher tolerance to pests and diseases [15] or to soil lime [16,17] and, possibly, to saline soils [18]. Also, their musts provide high intensity of color and good level of acidity, interesting characteristics for the production of quality red wines in Mediterranean areas [19]. These traits could be of high interest considering that global climate change will probably affect viticulture in next future and convert wild grapevine into a genetic pool useful for breeding [20].

On the other hand, the ability of some wild grapevines to store high concentrations of copper in roots from contaminated soils opens up a new research field on the phytoremediation capabilities of wild grapevine [21,22].

Considering the relevance of genetic resources for the future of the crop and their current and increasing scarcity, major efforts should be dedicated to the collection and characterization of this subspecies [23], cited in the white book on the Andalusian phyto-genetic resources to counterbalance the risk of genetic erosion [24].

Due to diverse anthropic impacts on natural habitats of wild grapevine, including the presence of invasive vines, such as American rootstocks and direct producer hybrids, their populations are disappearing in an alarming way,

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